

REMARKS

Favorable reconsideration of this application as presently amended and in light of the following discussion is respectfully requested.

Claims 1-12 are pending in the present application. Claims 2, 3, 7, 8, 11, and 12 are canceled and Claims 1, 4, 6, 9, and 10 are amended by the present amendment. Claims 13-18 are indicated as withdrawn in response to a previous restriction requirement.

In the outstanding Office Action, Claims 1, 3, and 4 were rejected under 35 U.S.C. § 102(e) as anticipated by U.S. Patent No. 6,528,399 to Alieu et al. (herein "Alieu"); and Claims 2 and 5-12 were rejected under 35 U.S.C. § 103(a) as unpatentable over Alieu in view of Applicant's acknowledged art.

Claims 1, 3, and 4 were rejected under 35 U.S.C. § 102(e) as anticipated by Alieu. That rejection is respectfully traversed.

Claim 1 is directed to, *inter alia*, a semiconductor device including

a first conductive type semiconductor region formed in a semiconductor substrate;

a gate electrode formed on said first conductive type semiconductor region; . . .

said gate electrode being formed of polycrystalline silicon-germanium, in which germanium concentration is continuously increased from a drain side to a source side.

Amended Claims 6 and 10 recite similar features.

In a non-limiting example, Figure 1 shows a semiconductor device having a gate electrode 8a formed in a p-type semiconductor region 2a of a semiconductor substrate 1. As shown in Figure 1b, the germanium concentration of the gate electrode 8a continuously increases from the drain side to the source side.¹

¹ Specification at page 5, lines 33-36.

Since the germanium concentration at the drain side is lower than that of the source side, the impurity activating concentration of the drain side is lower than that of the source side. Therefore, in the region near the drain region, to which a high electric field is applied, since a depletion layer expands in the gate electrode, depletion layer capacitance is connected in series to the capacitance between the gate electrode and the drain electrode. Accordingly, the gate capacitance is effectively decreased to moderate the electric field at the drain edge, thereby inhibiting the degradation of the gate breakdown voltage at the drain edge. Further, even if miniaturization of devices is carried out, it is possible to inhibit degradation of performance.²

Applicant respectfully submits that Alieu does not teach or suggest germanium concentration that continuously increases from the drain side to the source side. Alieu discloses only a gate electrode of polycrystalline silicon-germanium, in which the germanium concentration at the drain side is substantially equal to the germanium concentration at the source side, and the germanium concentration at both sides is higher than that of the central portion. For example, in Figures 3-6, Alieu shows a semiconductor device with a polycrystalline silicon-germanium gate electrode having germanium concentration at both the drain and source sides that is higher than the germanium concentration at the center, and Alieu does not show a germanium concentration that is higher on the drain side than that of the source side. Thus, it is respectfully submitted that Alieu does not teach or suggest “gate electrodes being formed of polycrystalline silicon-germanium, in which germanium concentration is continuously increased from the drain side to the source side,” as in the independent claims.

Accordingly, it is respectfully requested that rejection be withdrawn.

² Specification at page 6, lines 16-30.

Claims 2 and 5-12 were rejected under 35 U.S.C. § 103(a) as unpatentable over Alieu in view of Applicant's acknowledged art. That rejection is respectfully traversed.

Claims 2 and 5-12 depend on Claims 1, 6, and 10, which as discussed above are believed to be allowable. Further, it is respectfully submitted Applicant's admitted art also does not teach or suggest features recited in the independent claims. Furthermore, Applicant respectfully traverses the statement in the outstanding Office Action that

it would have been obvious to one having ordinary skill in the art at the time of the invention was made to modify Alieu et al. by having the germanium concentration in said gate electrode being continuously increased from the drain side to the source side for the purpose of improving the current flow in a semiconductor transistor, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art.³

Applicant respectfully submits that the claimed approach of continually increasing a germanium concentration from a drain side to a source side is not merely the "discovery of an optimum value of a result effective variable in a known process."⁴ Applicant respectfully submits that in Boesch, lowering of an electron average vacancy concentration throughout a CO-Cr-Ni alloy was expressly suggested in the cited reference. Thus, the Boesch court found that the kind of experimentation necessary to achieve the claimed composition would have been known within the skill of the art by varying the value of an result effective variable, the average electron vacancy concentration.⁵ On the contrary, the structure of continuously decreasing the concentration of germanium in a gate electrode from a drain side to a source side in the claimed invention is not suggested by Alieu. Further, the structure of the gate electrode in which germanium concentration is continuously increased from a drain side to a source side is a *structure* of the claimed apparatus and is not merely "an optimum value of a

³ Office Action mailed June 9, 2003, at page 4, lines 1-6.

⁴ In re Boesch, 617 F.2d 272, 276 (CCPA, 1980).

⁵ Id.


result effective variable in a known process.”⁶ Thus, Applicant respectfully submits that varying a result effective variable in Alieu might result in a gate electrode having a different lower concentration at the center and a different higher concentration at both drain and source sides, but would not result in the different *structure* of the claimed invention having a gate electrode with continuously decreasing germanium concentration from a drain side to a source side. Accordingly, it is respectfully requested that rejection also be withdrawn.

Accordingly, it is respectfully submitted independent Claims 1, 6, and 10 and each of the claims depending therefrom are allowable.

Consequently, in light of the above discussion and in view of the present amendment, the present application is believed to be in condition for allowance and an early and favorable action to that effect is respectfully requested.

Respectfully submitted,

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⁶ Id.